

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY


(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

REC'D 13 FEB 2006

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Applicant's or agent's file reference 11321P079WO		FOR FURTHER ACTION		See Form PCT/PEA/416
International application No. PCT/US2004/035894		International filing date (day/month/year) 28.10.2004	Priority date (day/month/year) 31.10.2003	
International Patent Classification (IPC) or national classification and IPC C01B31/02, C01B31/00				
Applicant WILLIAM MARSH RICE UNIVERSITY et al.				
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 8 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input type="checkbox"/> sent to the applicant and to the International Bureau a total of sheets, as follows:</p> <p><input type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>				
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input checked="" type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input checked="" type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input checked="" type="checkbox"/> Box No. VIII Certain observations on the international application</p>				
Date of submission of the demand 11.05.2005		Date of completion of this report 10.02.2006		
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465		Authorized Officer Marucci, A Telephone No. +49 89 2399-		



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Box No. 1 Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language, which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
 - ☐ publication of the international application (under Rule 12.4)
 - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

Description, Pages

1-14 as originally filed

Claims, Numbers

1-14 as originally filed

Drawings, Sheets

1/4-4/4 as originally filed

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to sequence listing (*specify*):

* If item 4 applies, some or all of these sheets may be marked "superseded."

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Box No. IV Lack of unity of invention

1. ☐ In response to the invitation to restrict or pay additional fees, the applicant has:
- ☐ restricted the claims.
 - ☐ paid additional fees.
 - ☐ paid additional fees under protest.
 - ☐ neither restricted nor paid additional fees.
2. ☒ This Authority found that the requirement of unity of invention is not complied with and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.
3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is
- ☐ complied with.
 - ☒ not complied with for the following reasons:
see separate sheet
4. Consequently, this report has been established in respect of the following parts of the international application:
- ☒ all parts.
 - ☐ the parts relating to claims Nos. .

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	3,5,10,11
	No: Claims	1,2,4,6-9,12-14
Inventive step (IS)	Yes: Claims	3,5,10,11
	No: Claims	1,2,4,6-9,12-14
Industrial applicability (IA)	Yes: Claims	1-14
	No: Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

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Box No. VI Certain documents cited

1. Certain published documents (Rule 70.10)
and /or
2. Non-written disclosures (Rule 70.9)
see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

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Re Item IV.

1. The separate inventions are:

Claims 1-11: Method to defunctionalize carbon nanotubes suspended in a solvent by heat treatment.

Claims 12-14: Method to defunctionalize carbon nanotubes dispersed in a composite material where the matrix is a polymer by heat-treatment.

1.1 They are not so linked as to form a single general inventive concept (Rule 13.1 PCT) for the following reasons:

Document D1 (see the list below) discloses a method for defunctionalizing carbon nanotubes contained in a polymer matrix by heat treating them (claims 97-103).

The common technical feature of the two inventions contained in this application, represented by the heat treatment process, does not, thus, make a contribution over the prior art and cannot be considered as a special technical feature within the meaning of Art. 13.2 PCT.

Furthermore, the properties of carbon nanotubes suspended in a solvent, like for instance water, disclosed in the first invention, cannot be resembled to the ones of carbon nanotubes in a polymer matrix, disclosed in the second invention. This appears to show lack of corresponding technical effect as well.

1.2 In conclusion, the groups of claims are not linked by common or corresponding special technical features and define two different inventions not linked by a single general inventive concept.

Re Item V.

2. Reference is made to the following documents:

D1 : WO 02/060812 A (WILLIAM MARSH RICE UNIVERSITY; TOUR, JAMES, M;
BAHR, JEFFREY, L; YANG,) 8 August 2002 (2002-08-08)

- D2: LIN YI ET AL: "Characterization of Functionalized Single-Walled Carbon Nanotubes at Individual Nanotube-Thin Bundle Level" J PHYS CHEM B; JOURNAL OF PHYSICAL CHEMISTRY B SEP 25 2003, vol. 107, no. 38, 25 September 2003 (2003-09-25), pages 10453-10457, XP002327973
- D3: DYKE, CHRISTOFER ET AL: "Diazonium-based functionalization of carbon nanotubes: XPS and GC-MS analysis and mechanistic implications" SYNLETT, no. 1, 8 December 2003 (2003-12-08), pages 155-160, XP002327962

3. Novelty objections (Article 33(2) PCT)

- 3.1 Document D1 discloses (the references in parentheses applying to this document): a method for defunctionalizing carbon nanotubes dispersed in a polymer matrix by heat treatment at a temperature of at least 250°C (claims 97-103).
- 3.2 Document D1 discloses in combination all the features defined in independent **claim 12**. Hence the subject-matter of this claim is not new.
- 3.3 Document D2 discloses (the references in parentheses applying to this document): a method for producing aminopolymer-functionalized carbon nanotubes. The sample obtained at the end of the functionalization process is made of functionalized carbon nanotubes suspended in an aqueous solution (first column of the second page "Functionalization of SWNTs with PPEI-EI"). The nanotubes are then defunctionalized through a heat treatment process (second column of the third page and first column of the forth page). The sample subjected to the heat treatment is clearly a solution as can be deduced by the sentence "to keep the SWNTs well dispersed".
- 3.4 In light of this document, the subject-matter of **claim 1** is not new.
- 3.5 Dependent claims 2, 4, 6- 9, 13, 14 do not contain any features which, in combination

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with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty and/or inventive step (Article 33(2) and (3) PCT).

4. DEPENDENT CLAIMS 3, 5, 10, 11

The combination of the features of dependent claims 3, 5, 10, 11 are neither known from, nor rendered obvious by, the available prior art. The reasons are as follows: the subject-matter of the present application differs from the one of document D2 in that the heat-treatment is performed in an enclosed vessel at temperatures such that the solvent does not decompose or evaporate. The final product is therefore not in a dry state like in D2 and the comparative examples filed with this application show that this brings an improvement on the properties of the nanotubes obtained (in particular on their solubility). Furthermore, no indication is present in D2 concerning a selective defunctionalization during the heat-treatment.

Re Item VI.

6. A relevant P-document, document D3 published online on 8/12/2003, was cited in the international search report.

Re Item VIII.

- 7.1 The vague and imprecise statement in the description in paragraphs [0043] and [0056] "without departing from the spirit of the invention" implies that the subject-matter for which protection is sought may be different to that defined by the claims, thereby resulting in lack of clarity (Article 6 PCT) when used to interpret them.
- 7.2 The statement in the description "which is hereby incorporated by reference", referring to cited documents ([0056]), should be deleted (Guidelines C-ii 4.18). The patent

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description should, in fact, be **self contained** without reference to any other document.